

# Upper Susquehanna River Basin, New York State Comprehensive Flood Damage Reduction Feasibility Study



## Economic Analysis

Following preliminary cost-benefit analysis and discussions with local sponsors, Binghamton, Johnson City, Endicott, and Vestal were identified as areas for further detailed analysis to determine the feasibility of raising existing flood risk management (FRM) projects. Nonstructural solutions were investigated in Bainbridge, Binghamton, Chenango, Conklin, Elv, Greene, Kirkwood, Norwich, Oneonta, Owego, Sidney, Town of Union, Unadilla, Waverly, and Whitney Point.

### A Basin-Wide Problem

The Upper Susquehanna River Watershed in New York, including the Susquehanna River mainstream and its tributaries, has a long history of severe flooding and continues to experience extreme flood events - notably the events of 2006 and 2011 - that have caused the loss of life, extensive property damage and disruptions to critical services supporting communities.

### Study Goal

Recommend actions to manage and/or reduce flood risk in the Upper Susquehanna River Basin in New York.

### Study Authority

The Upper Susquehanna River Basin Comprehensive Flood Risk Management Study, New York - Resolution of the House Committee on Transportation and Infrastructure, Sept. 24, 2008, and Section 729 of the Water Resources Development Act of 1986, as amended.



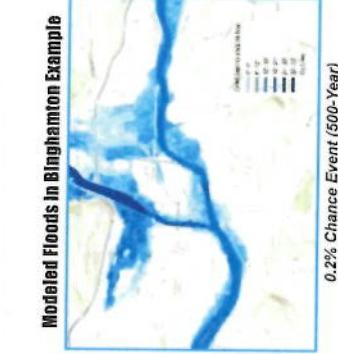
## About the Study

### Study Products

- Basin-Wide Hydrologic & Hydraulic Model
- Topographic Surveys
- National Levee Database
- Survey Updates
- Field Investigation Data
- USFWS Coordination
- Report:
  - Study Process
  - Engineering Appendix
  - Modeling
  - Cost Estimates
  - Climate Considerations
  - Economic Analysis
  - Concept Design Drawings

## Hydrologic & Hydraulic (H&H) Model

The USRB H&H Model was built on the best available data from the USACE and the Federal Emergency Management Agency (FEMA). This modeling can be used to update the FEMA Flood Insurance Study. The model can serve as a key component for the FEMA levee accreditation package and can be used to investigate new flood risk reduction projects or other areas of interest as well as help estimate effectiveness of future flood risk management measures.



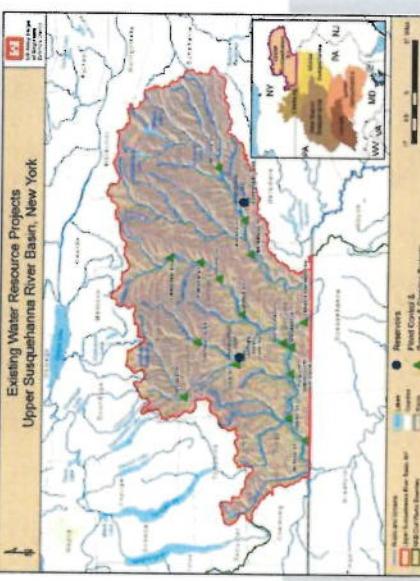
Looking for more information?

Visit our website:  
[https://www.nab.usace.army.mil/USRB\\_Feasibility\\_Study/](https://www.nab.usace.army.mil/USRB_Feasibility_Study/)

Questions?

Contact:  
[UpperSRBStudy@usace.army.mil](mailto:UpperSRBStudy@usace.army.mil)

Within New York, the Upper Susquehanna River Basin (USRB), excluding the Chemung River Watershed, drains approximately 4,520 square miles in the south central part of the state. USACE has constructed 20 flood risk management projects in the USRB dating back to 1938.



# CONKLIN AND KIRKWOOD, NEW YORK

## Upper Susquehanna River Basin (USRB) Comprehensive Flood Damage Reduction Feasibility Study

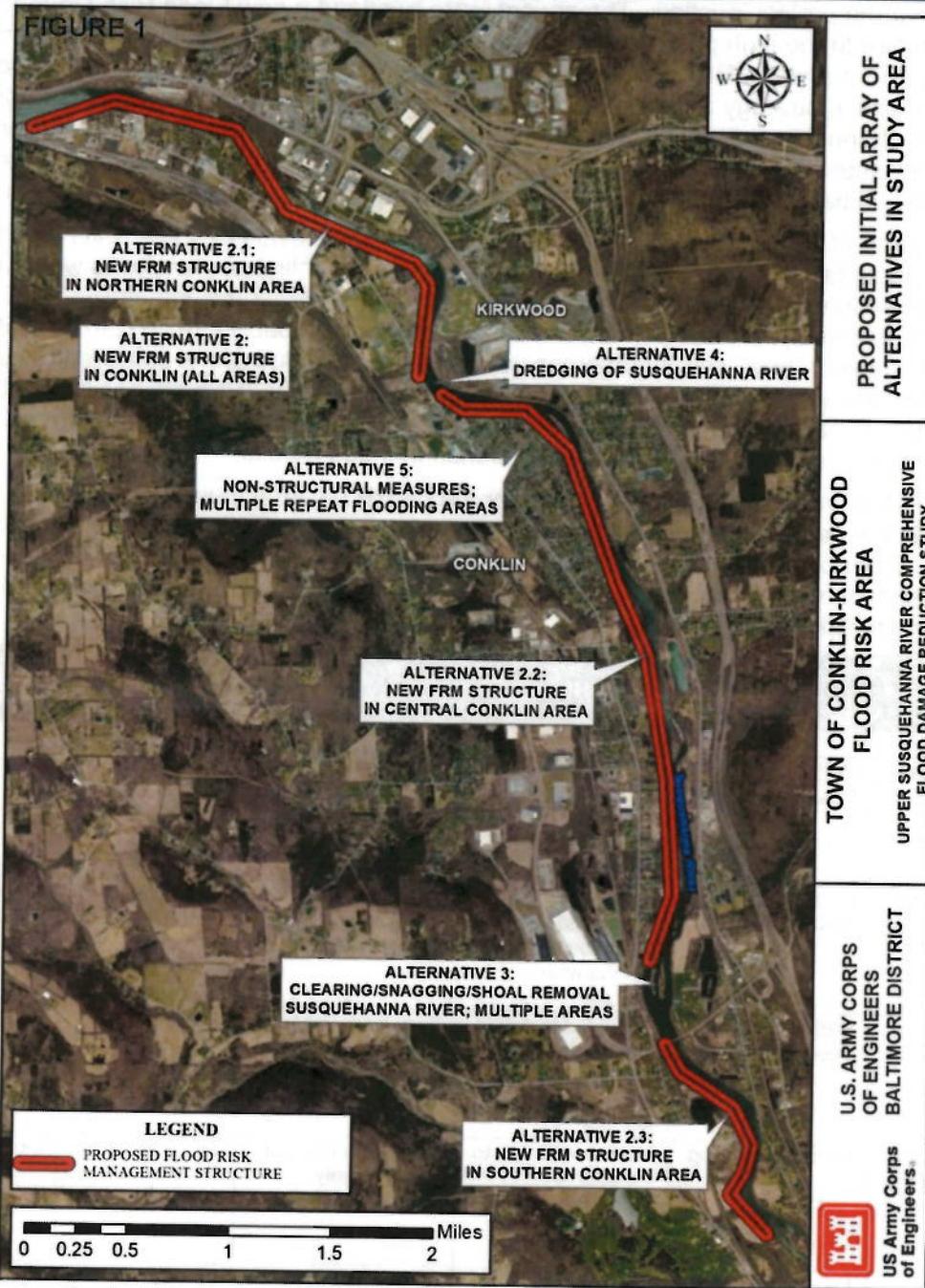
The USRB study assessed flood risk management alternatives using USACE criteria for evaluating large potential construction projects. Preliminary analysis was completed for evaluating project alternatives in Conklin, which experience(s) flooding during high frequency events resulting in high annualized damages for properties near the riverfront. Several structural alternatives demonstrated potential for a Federal project based on the benefits that could be realized by reducing flooding in Conklin and Kirkwood. Environmental impacts of a structural alternative in this area are expected to be very high based on the natural floodplain characteristics, important wetlands, and prime farmlands in the project area. There is also concern with a superfund site near the project location. The project team ruled out a new Flood Risk Management (FRM) project in Conklin due to the high potential for environmental impacts, possible induced flooding impacts to Kirkwood and the Binghamton FRM project downstream, and lack of local interest in the proposed structural alternative. The existing strategy for risk reduction in Conklin combines damage reduction from the existing Conklin-Kirkwood channel improvement project with non-structural measures for risk reduction in areas with recurring flooding issues. The PDT believes that this is the most appropriate risk reduction strategy for Conklin and Kirkwood based on the rural nature of the community and diffuse development in these towns.

For the focused array of alternatives, non-structural measures were evaluated in 4 reaches and 723 structures in the floodplain in Conklin and Kirkwood. Two sets of preliminary analyses were conducted using this model: (1) an evaluation of elevating the first floor elevation of residential structures and floodproofing non-residential structures up to the 1 percent annual exceedance probability (AEP) plus 1 foot, and (2) an examination of buyouts of these same properties using the market value and a unit cost for structure removal. The preliminary analysis indicates favorable benefit-cost ratios (BCR) associated with non-structural measures in some riverine reaches examined in this preliminary analysis. Further work is needed to reduce the level of uncertainty and improve confidence in these results.

**Bottom Line:** USACE recommends no action under the USRB General Investigation study. Despite the negative finding in the various structural alternatives examined, the preliminary analysis of non-structural measures results in a possible avenue for Federal involvement through existing grant mitigation programs and technical assistance programs. Non-structural analysis indicates favorable locations for non-structural measures in Conklin-Kirkwood.

FOCUS ARRAY OF ALTERNATIVES	ECONOMIC JUSTIFICATION <sup>i</sup>	USACE ENGINEERING JUDGMENT	ENVIRONMENTAL ACCEPTABILITY	CONCEPT PLAN COSTS (IN MILLIONS)	RECOMMENDATION
Alternative 1: No Action					
Alternative 2: Build a new levee system in Conklin along all three damage areas	Preliminary Positive Finding	Not feasible due to impacts to Kirkwood and Binghamton System	Very High Impacts Likely; Likely Unacceptable	\$60 - \$72	Does not meet all criteria
Alternative 2.1: Build new levee in Conklin along the Northern damage area	Preliminary Positive Finding	Not feasible due to impacts to Kirkwood and Binghamton System	Very High Impacts Likely; Likely Unacceptable	\$28 - \$34	Does not meet all criteria
Alternative 2.2: Build new levee in Conklin along the Central damage area	Preliminary Positive Finding	Not feasible due to impacts to Kirkwood and Binghamton System	Very High Impacts Likely; Likely Unacceptable	\$23 - \$28	Does not meet all criteria
Alternative 2.3: Build new levee in Conklin along the Southern damage area	Negative Finding	Not feasible due to impacts to Kirkwood and Binghamton System	Very High Impacts Likely; Likely Unacceptable	\$8 - \$10	Does not meet all criteria
Alternative 3: Clearing, Snagging, & Shoal Removal of Susquehanna River along Conklin-Kirkwood Area	Preliminary Positive Finding	Feasible	Moderate Impact Likely	\$7 - \$9	Existing project, no change

FOCUS ARRAY OF ALTERNATIVES	ECONOMIC JUSTIFICATION <sup>i</sup>	USACE ENGINEERING JUDGMENT	ENVIRONMENTAL ACCEPTABILITY	CONCEPT PLAN COSTS (IN MILLIONS)	RECOMMENDATION
Alternative 4: Dredging of Susquehanna River along Conklin-Kirkwood Area	Preliminary Positive Finding	Not Feasible	Very High Impacts Likely; Likely Unacceptable	\$21 - \$26	Does not meet all criteria
Alternative 5: Non-Structural Measures in Conklin and Kirkwood	Three reaches with preliminary Positive Findings	Feasible	Low Impacts Likely; Acceptable	High	Recommend nonstructural measures for damage reduction through existing grant programs and technical assistance



<sup>i</sup> A proposed alternative is considered economically justifiable if the benefit cost ratio is above parity (greater than or equal to one) and net benefits are positive (the difference between benefits and costs results in a positive benefit to the Nation). Initial economic analysis estimated preliminary BCRs using parametric costs (instead of concept costs) and benefits based on 50 and 67 percent damage reduction assumptions for proposed alternatives.

# OWEGO, NEW YORK

## Upper Susquehanna River Basin (USRB) Comprehensive Flood Damage Reduction Feasibility Study

The USRB study assessed flood risk management alternatives using USACE criteria for evaluating large potential construction projects. Detailed analysis was completed using the Hydrologic Engineering Center's Flood Damage Reduction Analysis (HEC-FDA) tool, which estimates annualized damages and is used to estimate damage reduction benefits by comparing future with and without project conditions. The detailed analysis primarily focused on evaluating two alternatives; berm modification with new levees and floodwalls (Alternative 2) and non-structural measures for damage reduction (Alternative 3). The results are summarized in the table and described in this fact sheet.

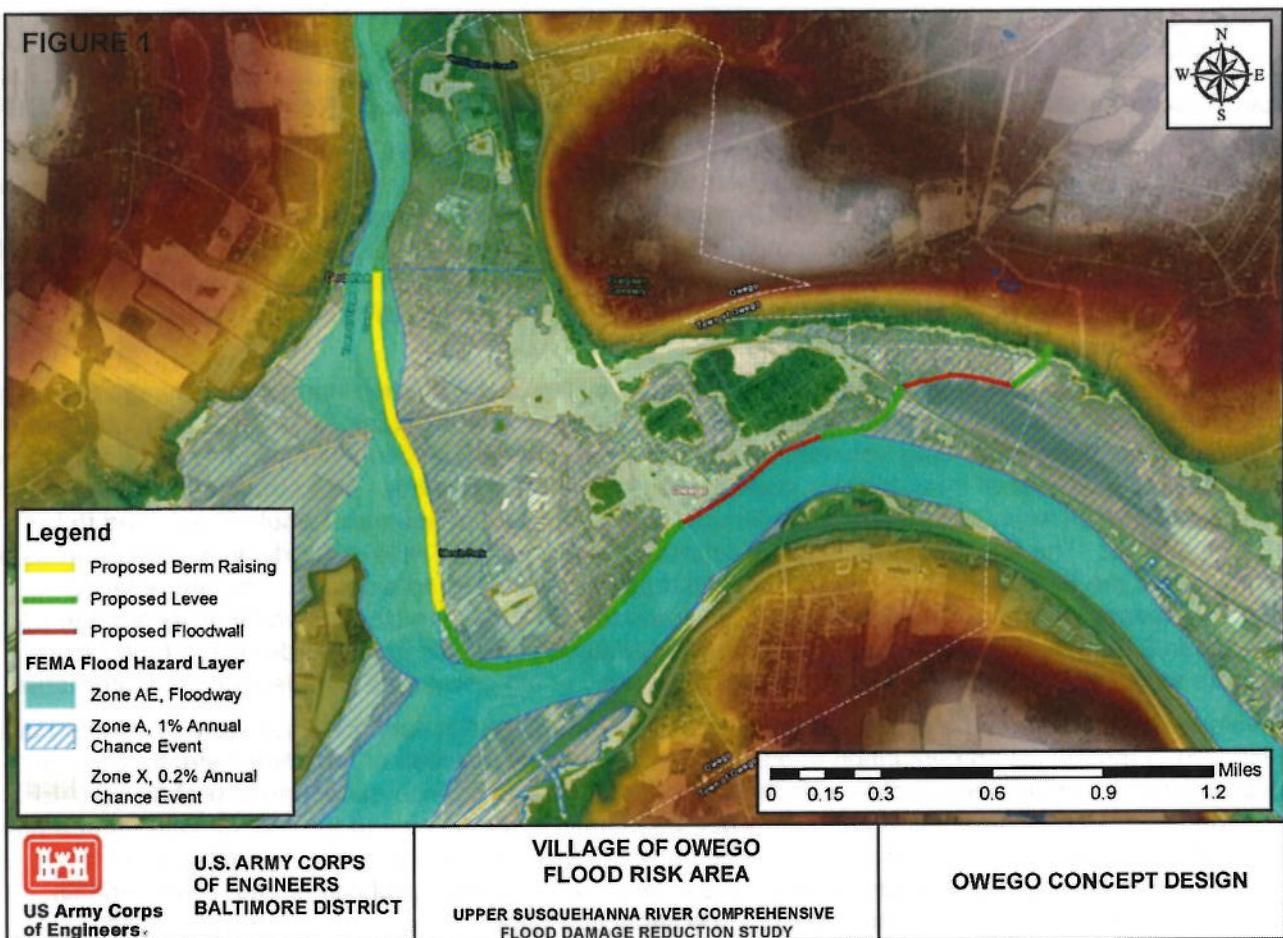
The project team developed conceptual designs for the raising of the existing berm along Owego Creek and a new levee and floodwall project to protect Downtown Owego up to the Brick Pond area. The conceptual level of design includes providing risk reduction to the 1 percent chance flood with two feet of freeboard for floodwalls and three feet of freeboard for levees using HEC-FDA modeling. This structural levee alternative assumes that the Owego Creek berm is inadequate due to poor foundation and would likely need to be rebuilt as a levee. The total length of levee is estimated at 2.3 miles, 1 mile of floodwall to protect areas of downtown and the Brick pond area, three road closures, and two railroad closures. The top of levee alignment elevations vary between 3 feet to 10 in some areas. Only one closure would likely need to be greater than 2 feet, the 5th Avenue closure, thus the remaining closures may be addressed by temporary measures such as sandbags. Cost estimates are currently being developed for this proposed alternative.

To evaluate non-structural measures (Alternative 3), two sets of preliminary analyses were conducted using the HEC-FDA model: (1) an evaluation of elevating the first floor elevation of residential structures and floodproofing non-residential structures up to the 1 percent annual chance exceedance probability (AEP) plus 1 foot, and (2) an examination of buyouts of these same properties using the market value and a unit cost for structure removal. The Village of Owego non-structural analysis includes 1 reach and 474 structures. The BCR for non-structural measures is less than one and results in negative net benefits. Further work is needed to reduce the level of uncertainty and improve confidence in these results.

**Bottom Line:** USACE recommends no action under the USRB General Investigation study. Pending the results of the cost estimate and the economic analysis, it is likely that a project in Owego would fall under the Continuing Authorities Program Section 205 investigation for a small flood risk management project to reduce risk in the Village of Owego.

ALTERNATIVES	ECONOMIC JUSTIFICATION <sup>i</sup>	USACE ENGINEERING JUDGMENT	ENVIRONMENTAL ACCEPTABILITY	CONCEPT PLAN PARAMETRIC COSTS (IN MILLIONS)	RECOMMENDATION
Alternative 1: No Action	-	-	-	-	
Alternative 2: Raising of the existing berm along Owego Creek and a new levee and floodwall project in Downtown Owego	Not Yet Determined	Feasible	Moderate Impacts Likely; High Cultural/Historic Impacts	Pending Estimates	Pending analysis; Likely feasible under an existing Continuing Authorities Program authority
Alternative 3: Non-structural measures in the Village and Town of Owego	Negative Finding	Feasible	Low Impacts Likely; Acceptable	Moderate	Does not meet all criteria.

FIGURE 1



US Army Corps  
of Engineers

U.S. ARMY CORPS  
OF ENGINEERS  
BALTIMORE DISTRICT

VILLAGE OF OWEGO  
FLOOD RISK AREA  
UPPER SUSQUEHANNA RIVER COMPREHENSIVE  
FLOOD DAMAGE REDUCTION STUDY

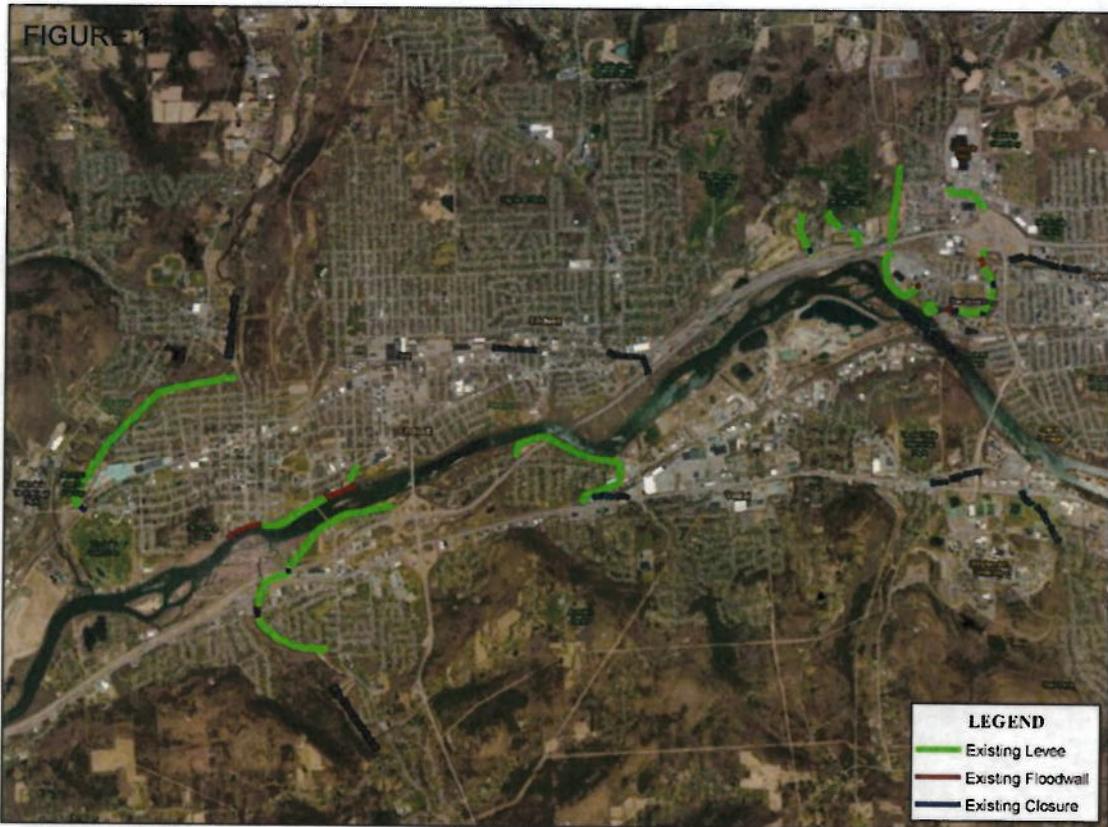
OWEGO CONCEPT DESIGN

<sup>i</sup> A proposed alternative is considered economically justifiable if the benefit cost ratio is above parity (greater than or equal to one) and net benefits are positive (the difference between benefits and costs results in a positive benefit to the Nation). Initial economic analysis estimated preliminary BCRs using parametric costs (instead of concept costs) and benefits based on 50 and 67 percent damage reduction assumptions for proposed alternatives.

# ENDICOTT-JOHNSON CITY-VESTAL (EJV), NEW YORK

## Upper Susquehanna River Basin (USRB) Comprehensive Flood Damage Reduction Feasibility Study

The USRB study assessed flood risk management alternatives using USACE criteria for evaluating large potential construction projects. Following a preliminary analysis of initial alternatives, the PDT developed parametric cost estimates for the conceptual raising of levees and floodwalls in EJV. Cost estimates used unit cost assuming an average of 2 feet of raising is needed throughout the system, which is based on escalated unit costs from the Value Engineering Study for Lackawanna River Flood Risk Management Project dated September 2011. The total lengths used includes 11,110 feet of levee and 2,200 feet of floodwall raising at Endicott, 21,700 feet of levee and 174 feet of floodwall in Vestal, and 9,950 of levee and 450 feet of floodwall at Johnson City. Preliminary cost estimates did not include estimated costs for raising or replacement of closure structures, nor do they include operation and maintenance costs, any needed mitigation costs, or real estate; therefore, these estimates likely underestimate the construction costs of the proposed alternative. The cost estimates were used for the purposes of screening since initial analysis indicated that levee raising is unlikely to be economically justifiable at the EJV project. HEC-FDA modeling was used to estimate damages at each of the levee systems and compare costs to benefits assuming two levels of damage reduction, 50 percent and 100 percent (although no FRM project is likely to reduce damages by 100 percent). No detailed engineering concept designs were completed because comparisons of parametric costs with the initial HEC-FDA damages were unlikely to result in a favorable benefit cost ratio (BCR).

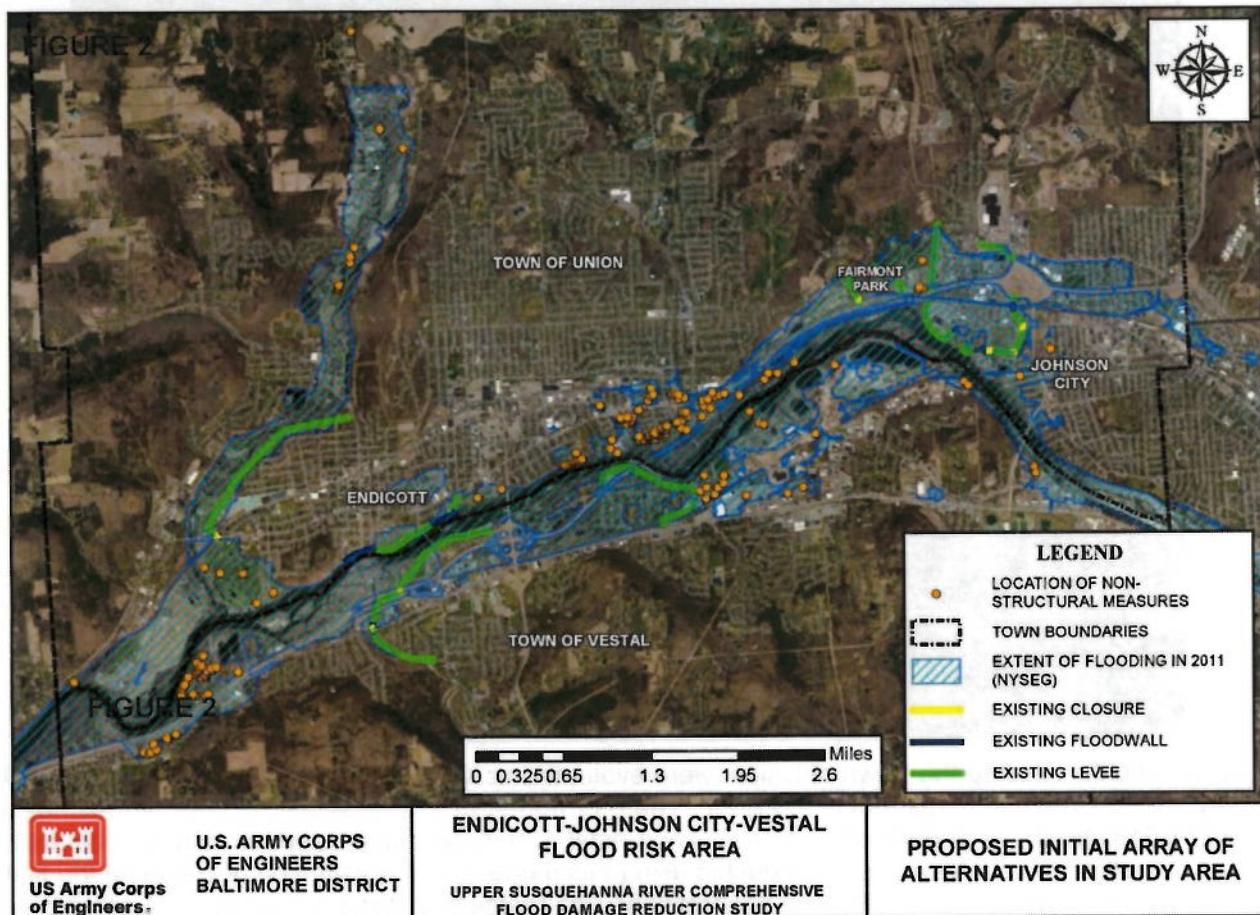


Structures in EJV, including the Town of Union, were evaluated using HEC-FDA modeling to determine the feasibility of non-structural measures in this area. The EJV non-structural analysis includes 38 reaches that include of 3,518 structures in Endicott, Johnson City, Vestal, Union, and upstream/downstream communities. Two sets of preliminary analyses were conducted using this model: (1) an evaluation of elevating the first floor elevation of residential structures and floodproofing non-residential structures up to the 1 percent annual exceedance probability (AEP) plus 1 foot, and (2) an examination of buyouts of these same properties using the market value and a unit cost for structure removal. The preliminary analysis indicates favorable BCRs associated with non-structural measures in some riverine reaches examined in this

preliminary analysis. Further work is needed to reduce the level of uncertainty and improve confidence in these results.

**Bottom Line:** USACE recommends no action under the USRB General Investigation study. Despite the negative finding in the various structural alternatives examined, the preliminary analysis of non-structural measures results in a possible avenue for Federal involvement through existing grant mitigation programs and technical assistance programs. Non-structural analysis indicates favorable locations for non-structural measures in EJV and the Town of Union. These areas are shown in Figure 2 with an overlay of flooding extent from Tropical Storm Lee in 2011.

FOCUS ARRAY OF ALTERNATIVES	ECONOMIC JUSTIFICATION <sup>i</sup>	USACE ENGINEERING JUDGMENT	ENVIRONMENTAL ACCEPTABILITY	CONCEPT PLAN PARAMETRIC COSTS (IN MILLIONS)	RECOMMENDATION
Alternative 1: No Action	-	-	-	-	-
Alternative 2: levee and floodwall raising in Endicott, Johnson City, and Vestal	Negative Finding	Feasible	Low Impacts Likely; Acceptable	\$65.2	Does not meet criteria for further consideration due to economic evaluation.
Alternative 3: Non-structural measures in EJV	Nine reaches with preliminary Positive Findings	Feasible	Low Impacts Likely; Acceptable	Moderate	Recommend non-structural measures for damage reduction through existing grant programs and technical assistance



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# ONEONTA, NEW YORK

## Upper Susquehanna River Basin (USRB) Comprehensive Flood Damage Reduction Feasibility Study

The USRB study assessed flood risk management alternatives using USACE criteria for evaluating large potential construction projects. The preliminary analysis, presented at the previous watershed screening meeting, was used to rule out channel clearing and dredging as risk reduction alternatives in the City of Oneonta (NY). Detailed analysis was completed using the Hydrologic Engineering Center's Flood Damage Reduction Analysis (HEC-FDA) tool, which estimates annualized damages and is used to estimate damage reduction benefits by comparing future with and without project conditions. The detailed analysis primarily focused on evaluating two alternatives; raising the Mill Race levee (Alternative 2) and non-structural measures for damage reduction (Alternative 3). The results are summarized in the table and described in this fact sheet.

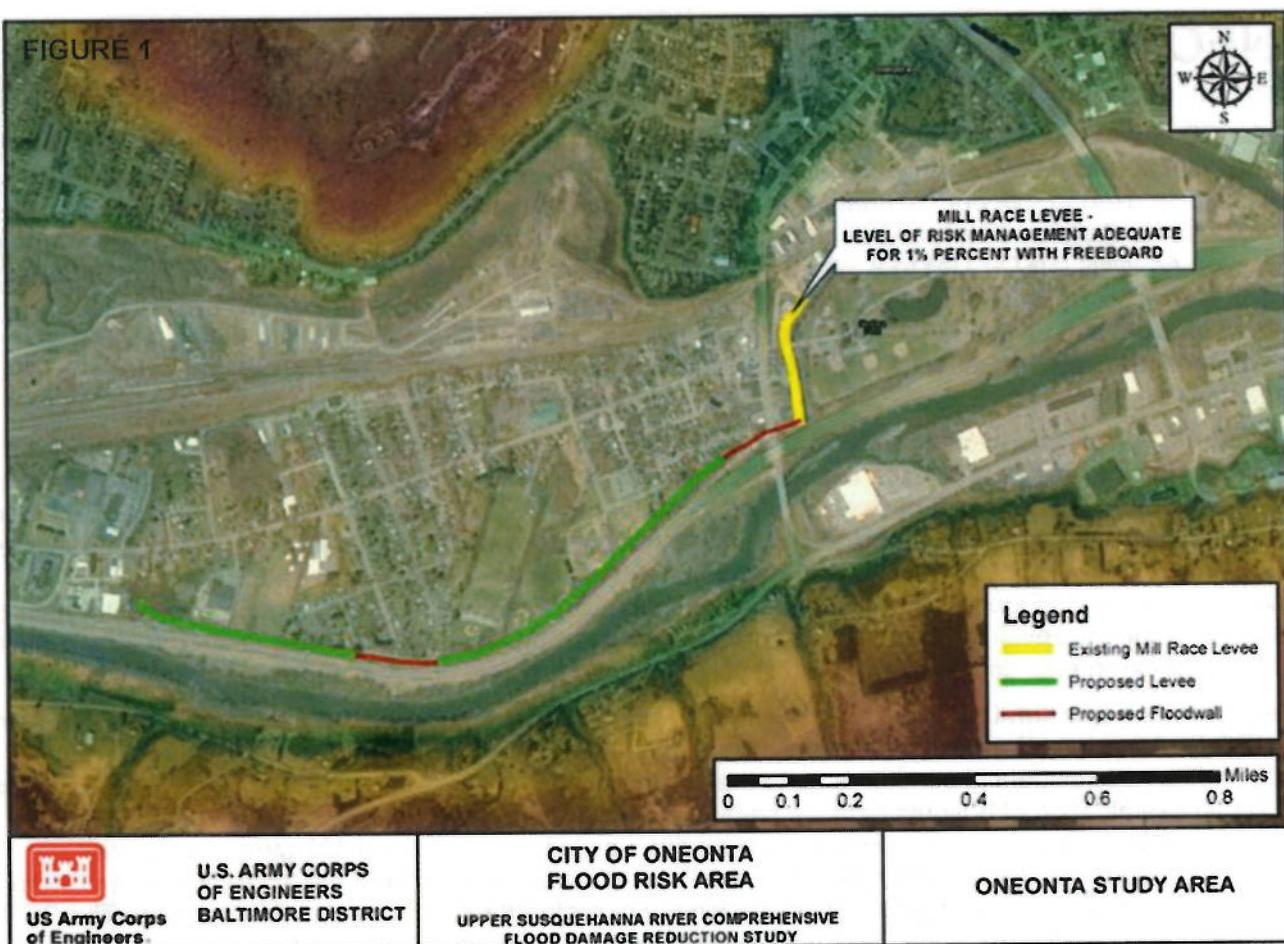
Alternative 2 is a structural alternative for raising of the existing, non-federal Mill Race levee. An examination of existing documentation and levee elevations against modeled water surface elevations for the 1 percent annual chance flood with 3 feet of freeboard indicated that the levee already reduces risk to National Flood Insurance Program (NFIP) levee accreditation standards. However, the Interstate-88 highway embankment may not meet NFIP standards due its pervious foundation so a levee may be needed to tie-in to the Mill Race levee (shown in Figure 1). A closure is also needed on Main Street at the location of the Interstate-88 overpass. Economic evaluation of the levee raising alternative using HEC-FDA calculated damage reduction and concept parametric costs yields a benefit cost ratio (BCR) below one and negative net benefits.

To evaluate non-structural measures (Alternative 3), two sets of preliminary analyses were conducted using the HEC-FDA model: (1) an evaluation of elevating the first floor elevation of residential structures and floodproofing non-residential structures up to the 1 percent annual exceedance probability (AEP) plus 1 foot, and (2) an examination of buyouts of these same properties using the market value and a unit cost for structure removal. The Oneonta non-structural analysis includes 1 reach and 187 structures in the City. Since these structures are currently receiving damage reduction benefits from the accredited levee, there would likely be limited remaining benefits to implement non-structural measures at this location. The BCR for non-structural measures is also less than one and results in negative net benefits.

**Bottom Line:** USACE recommends no action under the USRB General Investigation study. USACE is also recommending that the closure structure on Main Street be investigated under USACE technical assistance programs to include (1) surveying Main Street, (2) comparing water surface elevations versus needed design elevations at Main Street, and (3) comparing design alternatives for a closure on Main Street. Once the technical analysis is completed, design and construction of the closure may be appropriate for USACE Continuing Authorities Programs or FEMA grant assistance.

ALTERNATIVES	ECONOMIC JUSTIFICATION <sup>1</sup>	USACE ENGINEERING JUDGMENT	ENVIRONMENTAL ACCEPTABILITY	CONCEPT PLAN PARAMETRIC COSTS (IN MILLIONS)	RECOMMENDATION
Alternative 1: No Action	-	-	-	-	Technical Assistance Programs for Main Street Closure
Alternative 2: Raise existing non-federal Mill Race levee at Neahwa Place	Negative Finding, HEC-FDA benefits re-run as protected, low damage reduction benefits	Feasible	Low Impacts Likely; Acceptable	\$1.8 - \$2.2	Does not meet all criteria, existing damage reduction results in low benefits. Existing levee provides protection to 1% chance event with freeboard.
Alternative 3: Non-Structural Measures for Oneonta	Negative Finding, negative net benefits	Feasible	Low Impacts Likely; Acceptable	Low	Does not meet all criteria, preliminary analysis results in negative net benefits for floodproofing/elevation and buyouts.

FIGURE 1

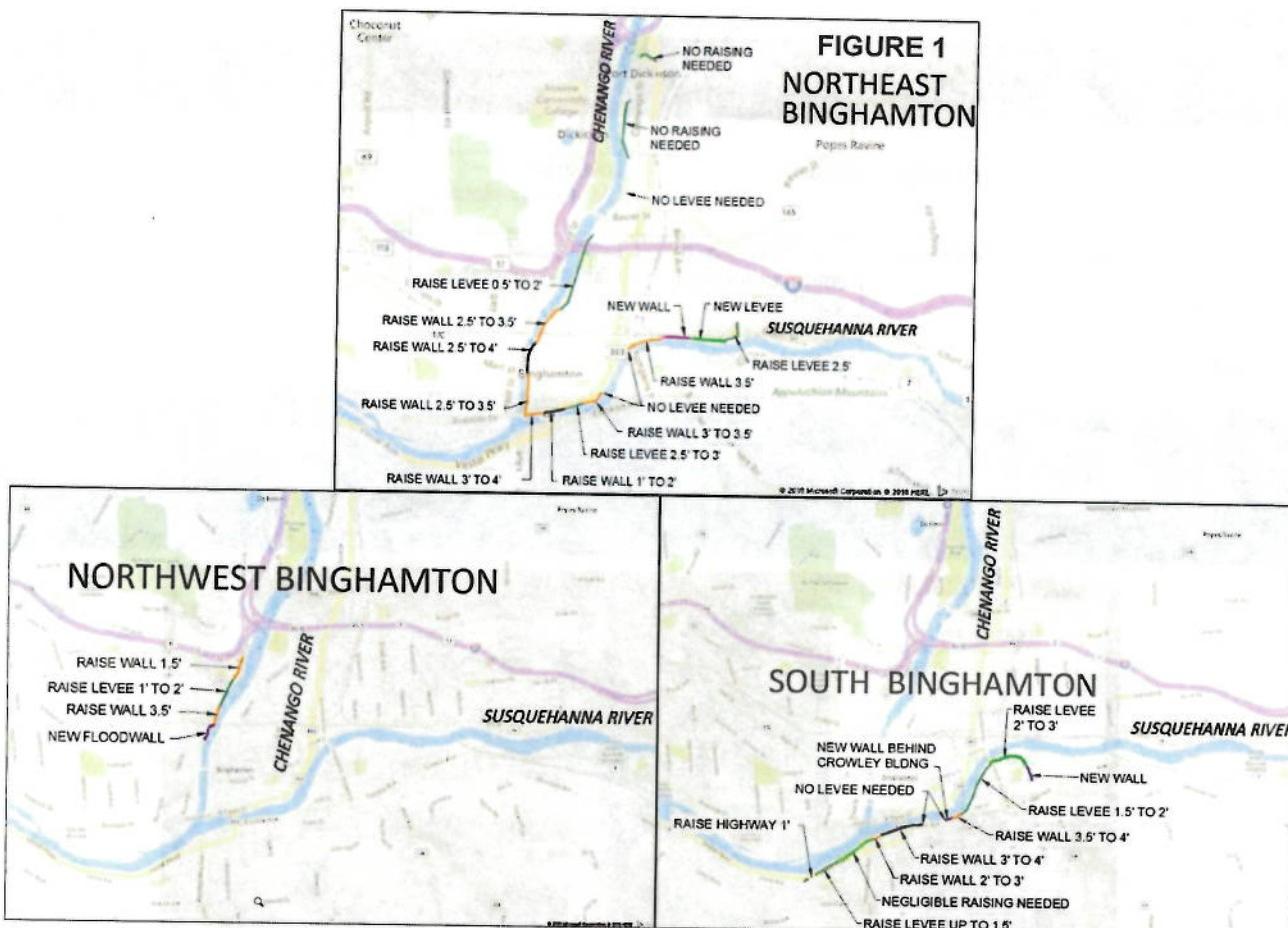


<sup>1</sup> A proposed alternative is considered economically justifiable if the benefit cost ratio is above parity (greater than or equal to one) and net benefits are positive (the difference between benefits and costs results in a positive benefit to the Nation). Initial economic analysis estimated preliminary BCRs using parametric costs (instead of concept costs) and benefits based on 50 and 67 percent damage reduction assumptions for proposed alternatives.

# BINGHAMTON & PORT DICKINSON, NEW YORK

## Upper Susquehanna River Basin (USRB) Comprehensive Flood Damage Reduction Feasibility Study

The USRB study assessed flood risk management alternatives using USACE criteria for evaluating large potential construction projects. Preliminary analysis and initial project scoping promoted one major alternative to move forward for detailed analysis, Alternative 2, raising all levees and floodwalls in the Binghamton Flood Risk Management (FRM) project. The proposed design included raising the Binghamton FRM project to the 1 percent annual chance exceedance flood event with 3 feet of freeboard. The study team developed conceptual designs for the proposed raising, calculated quantities of materials, and estimated costs for proposed raising. The concept design is shown in Figure 1. Alternatively, the study team examined raising the Binghamton FRM project with replacement of some floodwalls with levees in each of the systems.



Detailed analysis was completed using the Hydrologic Engineering Center's Flood Damage Reduction Analysis tool, which estimates annualized damages and is used to estimate damage reduction benefits by comparing with and without project future conditions. The detailed analysis primarily focused on evaluating three different alternatives. Alternative 2-A, levee and floodwall raising, involves raising a majority of the FRM project in Binghamton 0.5 to 4 feet, excluding the Port Dickinson segment of the project. This would also entail new levee and floodwall segments along Court Street in Northeast Binghamton, a new floodwall at the USACE-maintained Pierce Creek segment in South Binghamton, extending the City maintained McDonald Avenue floodwall, and replacement of approximately 75% of all of the existing floodwalls in the FRM project, based on the needed level of raising to meet accreditation standards (1 percent design event with freeboard). A second alternative, 2-B, involves replacing floodwalls with levees at select locations. Results of the economic analysis are summarized in the table below. Neither structural alternative showed benefit-cost ratios (BCR) greater than one.

The Binghamton-Port Dickinson non-structural analysis includes 25 reaches with 4,629 structures in Binghamton, Port Dickinson, and the upstream communities of Chenango, Dickinson, Conklin, and

Kirkwood. Two sets of preliminary analyses were conducted using this model: (1) an evaluation of elevating the first floor elevation of residential structures and floodproofing non-residential structures up to the 1 percent annual exceedance probability (AEP) plus 1 foot, and (2) an examination of buyouts of these same properties using the market value and a unit cost for structure removal. The preliminary analysis indicates favorable BCRs associated with non-structural measures in some riverine reaches examined in this preliminary analysis. Further work is needed to reduce the level of uncertainty and improve confidence in these results.

**Bottom Line:** USACE recommends no action under the USRB General Investigation study. Despite the negative finding in the various structural alternatives examined, the preliminary analysis of non-structural measures results in a possible avenue for Federal involvement through existing grant mitigation programs and technical assistance programs. Non-structural analysis indicates favorable locations for non-structural measures in the City of Binghamton. These areas are shown in Figure 2 with an overlay of flooding extent from Tropical Storm Lee in 2011.

FOCUS ARRAY OF ALTERNATIVES	ECONOMIC JUSTIFICATION <sup>i</sup>	USACE ENGINEERING JUDGMENT	ENVIRONMENTAL ACCEPTABILITY	CONCEPT PLAN COSTS (IN MILLIONS)	RECOMMENDATION
Alternative 1: No Action	-	-	-	-	-
Alternative 2A: Levee and floodwall raising in the Binghamton FRM Project	Negative Finding	Feasible	Low Impacts Likely; Acceptable	\$120.2	Does not meet criteria for further consideration due to economic evaluation.
Alternative 2B: Levee and floodwall raising in the Binghamton FRM Project, with replacement of some floodwalls with levees	Negative Finding	Not feasible at this time, but may be feasible in the future due to proposed road realignments	Low Impacts Likely; Acceptable	\$122.5	Does not meet criteria for further consideration due to economic evaluation.
Alternative 3: Non-structural measures in Binghamton and Port Dickinson	Six reaches with preliminary Positive Findings	Feasible	Low Impacts Likely; Acceptable	Moderate	Recommend non-structural measures for damage reduction through existing grant programs and technical assistance



FIGURE 2

 U.S. ARMY CORPS OF ENGINEERS BALTIMORE DISTRICT	<b>BINGHAMTON-PORT DICKINSON FLOOD RISK AREA</b> <small>UPPER SUSQUEHANNA RIVER COMPREHENSIVE FLOOD DAMAGE REDUCTION STUDY</small>	<b>PROPOSED INITIAL ARRAY OF ALTERNATIVES IN STUDY AREA</b>
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